## REMARKS

This is in response to the Office Action that was mailed on February 3, 2003. Claim 1 is amended to recite the pressure category minimum value of original claim 3. Claim 1 is also amended to recite seamless attachment as disclosed for instance in lines 18-24 on page 7 of the specification. Claim 3 is amended to recite the preferred Melt Flow Rate that was previously recited in claim 2. New claim 10 is based upon disclosure appearing in the paragraph bridging pages 6-7. New claim 11 is based upon the Examples. Minor formal amendments have been made to the claims. No new matter is introduced by this Amendment. Claims 1-11 are in the case.

Claims 1-9 were rejected under the second paragraph of 35 U.S.C. §112 as failing to define the invention properly. The claims have been amended to obviate the issues raised in this regard by the Examiner. (Applicants respectfully maintain that the "seamless" language is clear, and defines seamless layers adhered together.) The claims in their present form satisfy the requirements of the statute.

Claims 1-4, 8, and 9 were rejected under 35 U.S.C. §102(b) as being anticipated by US 5,236,018 (Kobayashi). The rejection is respectfully traversed.

The present claims are directed to pipes. The Examiner has not pointed to a pipe in Kobayashi that falls within the scope of any of the present claims. When a claim covers several structures or compositions, the claim is anticipated

if any of the structures or compositions within the scope of the claim is known in the prior art. *Titanium Metals Corp. of America v. Banner,* 227 USPQ 773, 778 (Fed. Cir. 1985). Where a specific example of a technique is disclosed in the prior art, the subsequent attempt to patent the genre to which that example belongs is anticipated. *Rheox, Inc. v. United Catalysts, Inc.,* cited on page 3-50 of "Chisum on Patents", Lexis Publishing, 2000. Compare *Akzo N.V. v. U.S. Int'l Trade Comm'n,* 1 USPQ2d 1241, 1246 (Fed. Cir. 1986)(no anticipation when one would have had "randomly to pick and choose among a number of different polyamides, a plurality of solvents and a range of inherent viscosities" to reach the clamed invention). The anticipation rejection is clearly not sustainable.

The fiber-reinforced plastic coverings of Kobayashi ***are formed by laminating a plurality of fiber reinforced plastic layers*** and metal pipes. Column 2, lines 59-61; column 4, lines 26-28; column 4, lines 46-50. Also, prepregs are used as fiber reinforcement plastic layers. Column 4, lines 43-45; column 6, lines 14-19. This method of preparation cannot lead to the seamless pressure pipes of the present invention.

In contrast to Kobayashi, the multi-layer pipes of the present invention may be prepared by using a cone extruder. This enables production of a pipe in which the layers are seamlessly attached to one another. Moreover, in the present invention, the reinforcement fibers are cross-oriented in the extruded material in successive layers, and they are oriented in the same manner essentially throughout the whole layer. See the specification, pages 6 and 7.

Applicants disagree strongly with the Examiner's statement concerning melt flow rates. The Kobayashi material can vary a great deal, polypropylene being mentioned only just as one alternative among many others. The selection of a MFR according to the present invention is not at all obvious. This is clear from the specification of the present application, in the portion describing prior art. Kobayashi provides no hint or advice concerning how to use $MFR_2$ of more than 1 for the polyolefin used as plastic material in the pipe of the present invention.

In summary, the Kobayashi product is targeted for a totally different use, has a totally different structure, and is produced in a manner totally different from the present invention.

Claims 5-7 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Kobayashi in view of DE 25 51 525 (Vegt). The rejection is respectfully traversed.

The Examiner acknowledges that Kobayashi does not teach that his pipes have the pressure pipe category required by the present claims. The Examiner argues that the property in question is presumed to be present in the Kobayashi pipes. The Examiner is respectfully asked to point to a particular pipe in Kobayashi which she believes might have a pressure category of PN 16 or greater according to ISO Standard 4065. (Enclosed for the convenience of the Examiner is a copy of International Standard ISO 4065.)

When convention al manufacturing techniques are used, the pressure categories of pressure pipes (PN) are in general 6, 8, and 10. Specification, page 5, lines 8-13. In contrast, because the products of the present invention are manufactured in a cone extruder, long-fiber reinforcements are oriented in different directions in successive layers, enabling the products of this invention to better withstand pressure inside the pipes, and achieving pressure categories of PN 16, 18, 20, and 22, or even higher. Specification, page 6, lines 13-18. This makes them especially suitable for conveying liquids and gases. See the specification, page 1, line 7. In contrast, the Kobayashi disclosure relates to bar-like moldings that are suitable for transmitting torque and impulsive force. Column 1, lines 14-23.

Kobayashi does not teach layers that are seamlessly attached to each other, as required by the present claims. However, in the parent application, the Examiner argued that "seamless pipe would obviously have been provide because it is well known in the art to make pipes seamless". Applicants disagree, and request that the Examiner document this unsubstantiated assertion.

The Examiner had also argued that seamlessness may be presumed to be inherent in Kobayashi because of "producing the pipes by filament winding method using impregnated fibers, or winding method using prepreg". Again, Applicants disagree, and note that they achieve seamlessness by an ***extrusion*** process that cross-orients the reinforcement fibers in the material in successive layers (see e.g. the specification, page 5, lines 9-26), not by ***winding***.

> In accordance with the invention, it is possible to manufacture multi-layer pipes in which the layers are seamless attached to each other, so that the layers will not detach from each other. Instead, when, for example, the state-of-the-art tape winding technique is used, the different layers may become detached form each other. Furthermore, the invention enables the desired surface properties to be obtained without detracting from the strength Thus the surface of a product according to the invention may be smooth, rough, resistant to chemicals, etc.

Specification, page 7, lines 18-24.

Regarding the Melt Flow Rate recited in claims 2 and 3, it is surprising that polyolefins with low molecular weight and Melt Flow Rates of more than 1 can be used in combination with fiber reinforcement, because traditionally polyolefins with high molecular width, that is, having Met Flow Rates below 1, are used for piping materials. It is especially surprising that the low molecular weight polyolefins can be used to make very strong and durable pressure-resistant pipes as in the present invention. Specification, page 7, lines 10-16.

The prior art of record likewise fails to teach or suggest long-fiber reinforcement length being at least 30 times the diameter of the long-fiber reinforcements (claim 5) and/or ranging from about 2-15 millimeter (claim 6). The prior art fails to teach or suggest that the reinforcement fibers can be oriented at 53° with respect to the longitudinal direction of the pipe.

The combined teachings of Kobayashi and Vegt would not lead a person of ordinary skill in the art to the multi-layer pressure pipe of the present invention. The invention of present claims 1-11 is neither taught nor suggested by Kobayashi, alone or in view of Vegt.

**Conclusion**

It is submitted for the reasons stated above that the present claims define patentable subject matter such that this application has been placed into condition for allowance.

If any questions remain regarding the above matters, please contact Applicants' representative Richard Gallagher (Reg. No. 28,781) at (703) 205-8008.

Pursuant to the provisions of 37 C.F.R. §§ 1.17 and 1.136(a), the Applicants hereby petition for an extension of one (1) month to June 3, 2003, in which to file a reply to the Office Action. The required fee of $110.00 is enclosed herewith.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,

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By____________________

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Enclosures:
Marked Up Version Showing Amendments;
International Standard ISO 4065.

***Marked Up Version Showing Amendments:***

IN THE SPECIFICATION:

On the first page, before line 5, insert the heading --FIELD OF THE INVENTION--.

On the first page, before line 7, insert the heading --BACKGROUND OF THE INVENTION--.

On page 5, before line 15, insert the heading --SUMMARY OF THE INVENTION--.

The paragraph beginning on line 15 of page 5 has been amended as follows:

> It is an object of the invention to provide plastic pressure pipes in which the pressure category is considerably higher than that of currently known corresponding pipes.

On page 8, before line 1, insert the heading --BRIEF DESCRIPTION OF THE DRAWINGS--.

On page 8, before line 14, insert the heading --DETAILED DESCRIPTION OF THE INVENTION--.

IN THE CLAIMS:

Amend the claims to read:

1. (twice amended) A multi-layer pressure pipe [(20)] comprising an extruded polyolefin matrix [of a plastic material,] containing cross-oriented long-fiber-reinforced layers, wherein the multi-layer pressure pipe [(20)] is formed by cone extrusion using as the extruder a cone extruder [(10)] which cross-orients the reinforcement fibers in the extruded material in the seamlessly attached successive layers [(21, 22, 23, 24), and wherein the material extruded is a polyolefin which contains long-fiber reinforcements] to provide a pressure pipe having a pressure category of PN 16 or greater according to ISO Standard 4065.

2. (twice amended) A multi-layer pressure pipe [(20)] according to claim 1, wherein the melt flow rate ($MFR_2$)(230°C, 2.16 kg) of the polyolefin is greater than 1[, and preferably from about 10-18g/10 min].

3. (twice amended) A multi-layer pressure pipe [(20)] according to claim 1, wherein the melt flow rate ($MFR_2$)(230°C, 2.16 kg) of the polyolefin is from about 10-18g/10 min [the pressure pipe (20) is a pressure pipe, the pressure category of which is PN 16 or higher according to standard ISO 4065].

4. (twice amended) A multi-layer pressure pipe [(20)] according to claim 1, wherein the polyolefin is polypropylene[,] and wherein the long-fiber reinforcements are glass fibers.

5. (twice amended) A multi-layer pressure pipe [(20)] according to claim 1, wherein the length of the long-fiber reinforcements is at least 30 times the diameter of the long-fiber reinforcements [fiber diameter].

6. (twice amended) A multi-layer pressure pipe [(20)] according to claim 1, wherein the length of the long-fiber reinforcements in the pressure pipe is on the order of magnitude of [from about 0.5-50 mm, preferably from about 1-20 mm, and most preferably] from about 2-15 mm.

7. (twice amended) A multi-layer pressure pipe [(20)] according to claim 1, wherein the amount of long-fiber reinforcements ranges [from about 5 to 95% by weight, and preferably] from about 25 to 75% by weight.

8. (twice amended) A multi-layer pressure pipe [(20)] according to claim 1, wherein the pressure pipe [(20)] has a double-layer structure.

9. (twice amended) A multi-layer pressure pipe [(20)] according to claim 1, wherein the pressure pipe [(20)] has a four-layer structure.

# Thermoplastic pipes — Universal wall thickness table

## 1 SCOPE AND FIELD OF APPLICATION

This International Standard sets out a universal wall thickness table for thermoplastic pipes.

## 2 REFERENCES

ISO 161, *Thermoplastics pipes for the transport of fluids — Nominal outside diameters and nominal pressures.*

ISO 497, *Guide to the choice of series of preferred numbers and of series containing more rounded values of preferred numbers.*

## 3 BASIC THEORY

Generally speaking, the wall thickness of thermoplastic pipes can be expressed as follows :

$$e = f\,(d_e;\ A;\ B;\ C;\ D) \qquad \ldots(1)$$

where

$e$ is the nominal wall thickness;

$d_e$ is the nominal outside diameter;

$A$ represents the physical influences (temperature, time);

$B$ represents the mechanical influences (internal pressure, external forces);

$C$ represents the chemical influences (contact reactions);

$D$ represents the material properties (long-term behaviour, temperature dependence, chemical resistance).

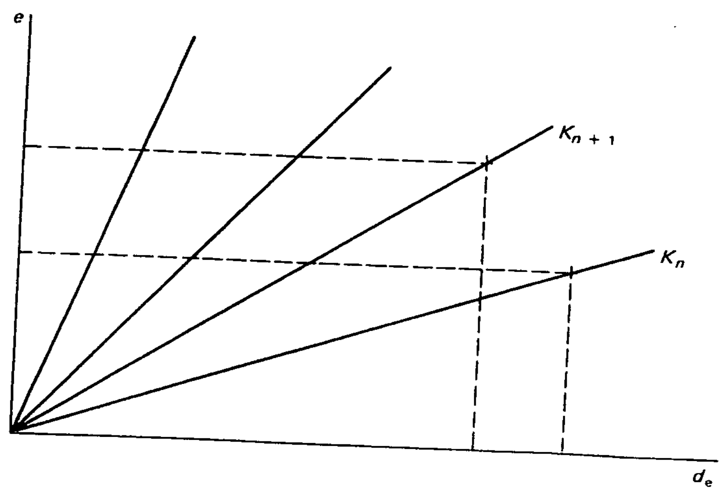
The simplest and (as will be shown later), for standardization purposes, a particularly apt version of equation (1) is :

$$e = K \times d_e \qquad \ldots(2)$$

where $K$ represents all application and material dependences $A$, $B$, $C$ and $D$ mentioned in equation (1).

However, equation (2) can also be intrepreted as a combination of purely geometrical values ($e$; $d_e$), $K$ being a parameter.

As the graph below shows, any combination of $e$ and $d_e$ can be obtained by varying the value of $K$.

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From the point of view of standardization, this fact implies the necessity of finding a minimum number of values for $K$ covering all pipe applications. Regarding these applications, the multitude of subjects under discussion in the working groups of TC 138 may be considered as representative. These subjects can be subdivided into the following two main groups :

a) *Pipes predominantly subject to internal pressure*

1) Pipes for the transport of cold water (pipes for water supply).

2) Pipes for the transport of water at elevated temperatures (hot water installations).

3) Pipes for the transport of fluids other than water (pipes for the chemical industry; pipes for the transport of gaseous fuels, except those operating at working pressures which are inadequate to overcome the influence of the external load).

b) *Pipes not subject to internal pressure*

This group comprises especially soil and waste pipes above ground as well as drainage and sewer pipes under earth load, transporting waste water or other fluids by gravity, not only at temperatures up to 20 °C but also at elevated temperatures.

## 4 PIPES PREDOMINANTLY SUBJECT TO INTERNAL PRESSURE

According to ISO 161, the wall thickness formula

$$e = \frac{1}{(2\,\sigma/p) + 1} \times d_e \qquad \text{. . .(3)}$$

where

$\sigma$ is the induced stress, and

$p$ is the pressure of the fluid,

applies originally only to subgroup a) 1) as defined in clause 3.

Equation (3) can also be considered as valid for subgroups a) 2) and a) 3) if the value of $\sigma$ is chosen appropriate to the particular application. In this case, $\sigma$ and $p$ comprise all application and material dependences $A$, $B$, $C$ and $D$ mentioned in equation (1). By expressing these dependences merely as a summary value $\sigma/p = S$, equation (3) may be transformed into :

$$e = \frac{1}{(2\,S) + 1} \times d_e \qquad \text{. . .(4)}$$

An identity between equations (2) and (4) requires that all values of $K$ can be converted into corresponding values of $S$ in agreement with the equation

$$K = \frac{1}{(2\,S) + 1} \qquad \text{. . .(5)}$$

This knowledge facilitates the selection of values of $K$ for group a), namely :

As already mentioned, in the case of group a), $S$ has the meaning of $\sigma/p$. In accordance with ISO 161, the values of $p$ have to be preferred numbers of the R 10 series for determining wall thicknesses of thermoplastic pipes. The values of $\sigma$ used in the past for calculation are fortunately also numbers of the R 10 series. Hence $S$ is always the quotient of two numbers of the R 10 series and therefore in principle is itself a number of the R 10 series. This is the key to the reduction of the numerous combinations of $\sigma$ and $p$ to a small selection of values of $S$.

Since preferred numbers are rounded off from theoretical values (calculated values : see ISO 497), quotients of preferred numbers cannot basically be identical either with preferred numbers or with their theoretical values. The latter, however, may be considered as mean values of all corresponding quotients. Therefore, a universal wall thickness table mathematically built up on the theoretical R 10 values for $S$ guarantees a minimum of deviations from wall thicknesses already laid down in existing standards and in papers of working groups.

The table on page 4 is the result of calculations based on the above procedure.

The nominal wall thicknesses ($e$) are expressed in millimetres to one decimal place and rounded up to the nearest 0,1 mm, if the second decimal is higher than zero.

## 5 PIPES NOT SUBJECT TO INTERNAL PRESSURE

The numerous pipe applications to be classified into group b), according to clause 3, are characterized only partially by a strictly linear relationship between $e$ and $d_e$ for pipes of identical material and similar conditions of use. Group b), therefore, does not represent the same justifying background for equation (2) as does group a). Yet, in many cases at least an approximately linear relationship between $e$ and $d_e$ is given. Moreover, the available basis for determining dimensions is very often much too rudimentary to permit convincing motivation for the creation of specific pipe series.

These facts justify the hope that an analogous method of selecting values for $K$ as developed for group a) might also be appropriate for group b). This assumption is actually true.

In consequence, there is no reason why pipes of group b) should be classified differently from those of group a).

## 6 CONCLUDING REMARKS

The practice of selecting minimum wall thicknesses higher than the theoretical values (if technical reasons are given), as well as the possibility of switching over, within the same application, to other series of the universal table, guarantee that the latter will provide a satisfactory solution to any future demand. Neither are complications to be expected

from new materials for pipes, owing to the fact that in view of values of $\sigma$ to be used for determining dimensions of pressure pipes, the R 10 series of preferred numbers offers a sufficiently differentiated selection to meet all technical and economic aspects. The assumption that a closer graduation in the $\sigma$-selection could lead to economical advantages is an error. The ratio $\left(\sqrt[10]{10} \approx 1{,}26\right)$ characterizing the R 10 series is adequate in view of the known scattering results of long-time tests as well as of the problems raised by their extrapolation and the determination of suitable factors of safety. Hence, a closer graduation of the $\sigma$-selection would be beyond the possibility of a serious differentiation.

For those exceptions where the general rule is not applicable for technical reasons, it may be necessary to take into account limited variations of wall thickness when preparing documents for these specific applications.

The advantage of a designation of series by means of $K$ or its reciprocal value lies in the additional information concerning the relationship $d_e/e$.

The mentioned advantage is also given for the designation of series with $S$ being in accordance with equation (4) :

$$S = \frac{1}{2}\left(\frac{d_e}{e} - 1\right) \approx \frac{1}{2} \times \frac{d_e}{e} \qquad \ldots (6)$$

Thus, any pipe can easily be classified on the basis of $d_e$ and $e$.

In addition, the $S$-values have the specific advantage of not forming a number series by chance but a pure series R 10. Furthermore, $S$ has in the case of pipes belonging to group a) the meaning of $\sigma/p$. That involves advantages for the dimensioning of hot water installations, and industrial pipes in particular. In consequence, there is no doubt that the designation of pipe series as used in the following table represents the optimal solution.

It will be of interest to note that the principles contained in this document have been used for a number of years in the United States of America in the form of the Standard Dimension Ratio (SDR) series. The relationship between the "SDR" and the "$S$", as defined in this document is given by the equation :

$$\mathrm{SDR} = \frac{d_e}{e} = 2S + 1 \qquad \ldots (7)$$

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TABLE – Nominal wall thicknesses ($e$), in millimetres, of the pipes series

| Nominal outside diameter $d_e$ mm | Pipe series $S$ | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2,5 | 3,2 | 4 | 5 | 6,3 | 8 | 10 | 12,5 | 16 | 20 | 25 | 32 | 40 | 50 | 63 |
| 2,5 | 0,5 | | | | | | | | | | | | | | |
| 3 | 0,5 | 0,5 | | | | | | | | | | | | | |
| 4 | 0,7 | 0,6 | 0,5 | | | | | | | | | | | | |
| 5 | 0,9 | 0,7 | 0,6 | 0,5 | | | | | | | | | | | |
| 6 | 1,0 | 0,9 | 0,7 | 0,6 | 0,5 | | | | | | | | | | |
| 8 | 1,4 | 1,1 | 0,9 | 0,8 | 0,6 | 0,5 | | | | | | | | | |
| 10 | 1,7 | 1,4 | 1,2 | 1,0 | 0,8 | 0,6 | 0,5 | | | | | | | | |
| 12 | 2,0 | 1,7 | 1,4 | 1,1 | 0,9 | 0,8 | 0,6 | 0,5 | | | | | | | |
| 16 | 2,7 | 2,2 | 1,8 | 1,5 | 1,2 | 1,0 | 0,8 | 0,7 | 0,5 | | | | | | |
| 20 | 3,4 | 2,8 | 2,3 | 1,9 | 1,5 | 1,2 | 1,0 | 0,8 | 0,7 | 0,5 | | | | | |
| 25 | 4,2 | 3,5 | 2,8 | 2,3 | 1,9 | 1,5 | 1,2 | 1,0 | 0,8 | 0,7 | 0,5 | | | | |
| 32 | 5,4 | 4,4 | 3,6 | 2,9 | 2,4 | 1,9 | 1,6 | 1,3 | 1,0 | 0,8 | 0,7 | 0,5 | | | |
| 40 | 6,7 | 5,5 | 4,5 | 3,7 | 3,0 | 2,4 | 1,9 | 1,6 | 1,3 | 1,0 | 0,8 | 0,7 | 0,5 | | |
| 50 | 8,3 | 6,9 | 5,6 | 4,6 | 3,7 | 3,0 | 2,4 | 2,0 | 1,6 | 1,3 | 1,0 | 0,8 | 0,7 | 0,5 | |
| 63 | 10,5 | 8,6 | 7,1 | 5,8 | 4,7 | 3,8 | 3,0 | 2,4 | 2,0 | 1,6 | 1,3 | 1,0 | 0,8 | 0,7 | 0,5 |
| 75 | 12,5 | 10,3 | 8,4 | 6,8 | 5,5 | 4,5 | 3,6 | 2,9 | 2,3 | 1,9 | 1,5 | 1,2 | 1,0 | 0,8 | 0,6 |
| 90 | 15,0 | 12,3 | 10,1 | 8,2 | 6,6 | 5,4 | 4,3 | 3,5 | 2,8 | 2,2 | 1,8 | 1,4 | 1,2 | 0,9 | 0,8 |
| 110 | 18,3 | 15,1 | 12,3 | 10,0 | 8,1 | 6,6 | 5,3 | 4,2 | 3,4 | 2,7 | 2,2 | 1,8 | 1,4 | 1,1 | 0,9 |
| 125 | 20,8 | 17,1 | 14,0 | 11,4 | 9,2 | 7,4 | 6,0 | 4,8 | 3,9 | 3,1 | 2,5 | 2,0 | 1,6 | 1,3 | 1,0 |
| 140 | 23,3 | 19,2 | 15,7 | 12,7 | 10,3 | 8,3 | 6,7 | 5,4 | 4,3 | 3,5 | 2,8 | 2,2 | 1,8 | 1,4 | 1,1 |
| 160 | 26,6 | 21,9 | 17,9 | 14,6 | 11,8 | 9,5 | 7,7 | 6,2 | 4,9 | 4,0 | 3,2 | 2,5 | 2,0 | 1,6 | 1,3 |
| 180 | 29,9 | 24,6 | 20,1 | 16,4 | 13,3 | 10,7 | 8,6 | 6,9 | 5,5 | 4,4 | 3,6 | 2,8 | 2,3 | 1,8 | 1,5 |
| 200 | | 27,3 | 22,4 | 18,2 | 14,7 | 11,9 | 9,6 | 7,7 | 6,2 | 4,9 | 3,9 | 3,2 | 2,5 | 2,0 | 1,6 |
| 225 | | | 25,1 | 20,5 | 16,6 | 13,4 | 10,8 | 8,6 | 6,9 | 5,5 | 4,4 | 3,5 | 2,8 | 2,3 | 1,8 |
| 250 | | | 27,9 | 22,7 | 18,4 | 14,8 | 11,9 | 9,6 | 7,7 | 6,2 | 4,9 | 3,9 | 3,1 | 2,5 | 2,0 |
| 280 | | | | 25,4 | 20,6 | 16,6 | 13,4 | 10,7 | 8,6 | 6,9 | 5,5 | 4,4 | 3,5 | 2,8 | 2,2 |
| 315 | | | | 28,6 | 23,2 | 18,7 | 15,0 | 12,1 | 9,7 | 7,7 | 6,2 | 4,9 | 3,9 | 3,2 | 2,5 |
| 355 | | | | | 26,1 | 21,1 | 16,9 | 13,6 | 10,9 | 8,7 | 7,0 | 5,6 | 4,4 | 3,5 | 2,8 |
| 400 | | | | | 29,4 | 23,7 | 19,1 | 15,3 | 12,3 | 9,8 | 7,8 | 6,3 | 5,0 | 4,0 | 3,2 |
| 450 | | | | | | 26,7 | 21,5 | 17,2 | 13,8 | 11,0 | 8,8 | 7,0 | 5,6 | 4,5 | 3,6 |
| 500 | | | | | | 29,6 | 23,9 | 19,1 | 15,3 | 12,3 | 9,8 | 7,8 | 6,2 | 5,0 | 4,0 |
| 560 | | | | | | | 26,7 | 21,4 | 17,2 | 13,7 | 11,0 | 8,8 | 7,0 | 5,6 | 4,4 |
| 630 | | | | | | | 30,0 | 24,1 | 19,3 | 15,4 | 12,3 | 9,8 | 7,9 | 6,3 | 5,0 |
| 710 | | | | | | | | 27,2 | 21,8 | 17,4 | 13,9 | 11,1 | 8,8 | 7,1 | 5,6 |
| 800 | | | | | | | | 30,6 | 24,5 | 19,6 | 15,7 | 12,5 | 10,0 | 7,9 | 6,3 |
| 900 | | | | | | | | | 27,6 | 22,0 | 17,6 | 14,0 | 11,2 | 8,9 | 7,1 |
| 1 000 | | | | | | | | | 30,6 | 24,5 | 19,6 | 15,6 | 12,4 | 9,9 | 7,9 |